

Research Assessment Exercise 2020
Impact Case Study

University: Hong Kong Baptist University

Unit of Assessment (UoA): 6 Chinese Medicine

Title of case study: Realizing standardization and internationalization of Chinese Medicines

(1) Summary of the impact

Lack of standardization has greatly restricted the development of Traditional Chinese Medicine (TCM). This case study will elucidate the important role of research on TCM standardization and internationalization in different aspects:

- a) Research results on quality control have been incorporated into different TCM standards and facilitated the establishment of the Government TCM Testing Institute.
- b) Online databases were established to provide digital multi-language reference resources.
- c) TCM publications and TV programs have contributed to its systematic consolidation with useful and updated information.
- d) Numerous research results in drug development have led to highly cited publications and grant of patents.

(2) Underpinning research

In Hong Kong, 50-60% of the population use TCM or a TCM product at least once in their lives [3.1]. Using the wrong TCM or TCM product may cause poisoning or death. Quality control is an important concern of the wider community, and is intricately connected to the future and development of Chinese medicine [3.2].

Standardization of Chinese Medicine

Prof. Zhao Zhongzhen, Professor of School of Chinese Medicine, and his team at Hong Kong Baptist University, have been at the forefront of strategic and adaptive research on the quality control of TCM [3.3-3.4]. Since 2002, we have worked as one of the research institutions for Hong Kong Chinese Materia Medica Standard (HKCMMS). With the development of modern analytical techniques, it is possible to identify, isolate and control the complex compounds in herbal drugs. In addition, the safety of herbal medicines can be ensured by assessing for components such as heavy metals, ash content and microbial contaminants. These research results of TCM quality control could provide guidance for government on regulatory and quality assurance standards to tackle misuse of poor quality, adulterated or counterfeit products. These seminal findings have laid the foundations for quality control by Hong Kong Chinese Materia Medica Standards (HKCMMS) [3a, 3b], the Chinese Pharmacopoeia (CP), and the United States Pharmacopoeia (USP).

Internationalization of Chinese Medicine

Prof. Chen Hubiao is the founder and director of the *Medicinal Plant Images Database*, *Chinese Medicinal Material Images Database* and *Phytochemical Images Database*. Featuring a combination of photos and text, the *Medicinal Plant Images Database* systematically categorizes and presents knowledge on over 1000 medicinal plants from Chinese and Western origins. Different platforms were established for information sharing and communication, such as sharing information about plant or herb images, chemical profiles and research data, or obtaining reliable objective information resources for researchers, public and industries. Profs. Zhao and Chen are the editors of a series of publications including *Encyclopedia of Medicinal Plants*, *Easily Confused Chinese Medicines in Hong Kong*, *Chinese Medicinal Identification*, and *Illustrated Microscopic Identification of Chinese Medicines*, in different languages, which serve as worldwide reference books of TCM. Prof. Zhao is the academic advisor of a 120-episode TV series *The Chinese Materia*

Medica For Us All, a popular program promoting the culture of Chinese medicine and disseminating knowledge about high quality herbal medicines to the public [3c].

Industrial Collaboration

The implementation and completion of this project will greatly contribute to traditional knowledge of experience-based Chinese medicinal differentiation, while elucidating its traditional technical terminology through modern scientific means (new techniques, digital images, and new technologies), which have much to offer to the worldwide area of TCM quality control for researchers, public and industries [3.5-3.6]. SCM established different centers to provide services for quality assurance, authentication and safety testing of Chinese medicines. A series of research results in new drug development and quality control has yielded highly-cited publications and granted patents [3d, 3e].

(3) References to the research

- 3.1 Zhao, Z. (2006). Authentication is fundamental for standardization of Chinese Medicines. *Planta Medica*, 72(10). Doi: DOI: 10.1055/s-2006-947209
- 3.2 Zhao, Z., Xiao, P., Xiao, Y., & Yuen, J. P. (2007). Quality assurance of Chinese herbal medicines (CHMs). *Journal of Food and Drug Analysis*, 15(4).
- 3.3 Eisenberg, D. M., Harris, E. S., Littlefield, B. A., Cao, S., Craycroft, J. A., & Zhao, Z. (2011). Developing a library of authenticated Traditional Chinese Medicinal (TCM) plants for systematic biological evaluation-rationale, methods and preliminary results from a Sino-American collaboration. *Fitoterapia*, 82(1), 17-33. Doi: 10.1016/j.fitote.2010.11.017.
- 3.4 Zhao, Z., Liang, Z., & Ping, G. (2011). Macroscopic identification of Chinese medicinal materials: traditional experiences and modern understanding. *Journal of ethnopharmacology*, 134(3), 556-564. di:10.1016/j.jep.2011.01.018.
- 3.5 Li, F., Lu, J., Liu, J., Liang, C., Wang, M., Wang, L., & Zhang, Z. K. (2017). A water-soluble nucleolin aptamer-paclitaxel conjugate for tumor-specific targeting in ovarian cancer. *Nature communications*, 8(1), 1390.
- 3.6 Liang, C., Peng, S., Li, J., Lu, J., Guan, D., Jiang, F., & Au, D. W. T. (2018). Inhibition of osteoblastic Smurf1 promotes bone formation in mouse models of distinctive age-related osteoporosis. *Nature communications*, 9(1), 3428.

Major research grants:

- 3a Hong Kong Standard of Chinese Materia Medica (Volume 8-10), Department of Health, HK\$ 4,609,510 (2014-2018)
- 3b Hong Kong Standard of Chinese Materia Medica (Decoction Pieces), Department of Health, HK\$ 1,579,423 (2016-2018)
- 3c Clarifying the Lingnan Medicinal Materials of Compendium of Materia Medica (Ben Cao Gang Mu), National Natural Science Foundation of China, HK\$ 875,000 (2014-2017)
- 3d HKBU-SHENZHEN TSUMURA MEDICINE CO LTD Pharmacognosy Laboratory, SHENZHEN TSUMURA MEDICINE CO LTD, HK\$5,000,000 (2015-2018)
- 3e Standardization on the Nomenclatures of Chinese Medicinal Materials and Decoction Pieces Sold in Hong Kong, Eu Yan Sang (HK) Limited and Innovation and Technology Fund, HK\$ 916,000 (2014-2015)

(4) Details of the impact

Prof. Zhao serves as honorary advisor of the Hong Kong Department of Health, a member of the USP Herbal Medicines Compendium, and an advisor on traditional medicine in the World Health Organization. Prof. Zhao and Prof. Lyu serve as members of Chinese Pharmacopoeia Commission. Research work of different Chinese materia medica (CMM) conducted by us provides guidance for the Government on regulatory and quality assurance standards to HKCMMS. Through continuous efforts, the Government has written in the Chief Executive's 2017 Policy Address to complete the

HKCMMS [5.1]. Testing laboratories, governmental institutes in Hong Kong conducted quality control tests according to HKCMMS. Our institutes were awarded ISO 17025 by the Hong Kong Accreditation Service for carrying out TCM tests for the public, industry and Government. We have supported the local Chinese medicine industry to enhance the quality, safety and efficacy of TCM products, and meanwhile to assist local Chinese medicines testing industry to develop new accredited testing services. We have facilitated the government's establishment of the Government Chinese Medicines Testing Institute, which was announced in the 2017 Policy Address.

A series of online databases, including *Medicinal Plant Images Database*, *Chinese Medicinal Material Images Database*, *Chinese Medicine Specimen Database* and *Phytochemical Images Database*, were established as a unified worldwide platform to provide new resources for TCM quality control. The databases document photographs and detailed information on over 420 crude drugs which are commonly used in Chinese medicine. The first two databases have had over 3,000,000 and 2,000,000 visitors respectively; this digital project was honored by the ALA Presidential Citations for Innovative International Library Projects [5.2]. The established databases have led to improved safety and promoted the development of Chinese medicine, as well as quality control in the industry [5.3]. The evolution of electronic sources had brought significant impact on reference collections in libraries and public researching behavior: encouraging users from print/paper references to digital ones.

A series of TCM books in different languages are popular around the world:

- *Easily Confused Chinese Medicines in Hong Kong*: more than 10,000 samples of medicinal materials were collected and authenticated. This book was published and distributed to the public. Following promotion and education by the Government and academia, adulterated medicinal materials in the herbal market decreased sharply [5.4-5.5].
- *Chinese Medicinal Identification*: published in different languages and systematically summarized the distinguishing macroscopic features of 428 commonly used CMM. As one of the top 100 publications in the science and technology category, it was awarded "selected original works prize" in the Chinese book campaign "three one-hundred" in 2012 [5.6].
- *Encyclopedia of Medicinal Plants*: Based on years of field research in China and abroad, this text contains information of the latest scientific literature, and features a comprehensive overview of the chemistry, pharmacology, and clinical applications of medicinal plants from around the world in different languages. In 2010, this text was awarded China's top prize for outstanding scientific publication [5.7].

Discovery Networks Asia Pacific has prepared a TCM series for international audiences, providing the world a way to genuinely connect to traditional Chinese medicine [5.8]. Our Chinese Medicines Centre displays more than 1,000 pieces of plant and animal specimens. Feedback from public showed that the Chinese Medicines Centre provided resources for teaching and research purposes [5.9]. In order to foster the development of internationalization and standardization of TCM, we collaborated with overseas/mainland institutions, professional groups, experts and scholars to promote TCM culture and elevate the international status of TCM in both the medical and academic areas. Our TCM culture projects facilitated the establishment of the Li Shizhen Museum, with 150,000 visitors per week and it is currently managed by the Hubei Provincial Government. Moreover, it facilitated the creation of an online digital archive that will include images and translations of various Chinese medical artifacts stored at the Kam Wah Chung & Co. Museum, a state park and a national historic landmark that preserves early Chinese medicine culture in the U.S. state of Oregon [5.10].

We have collaborated with different pharmaceutical companies to translate the research results and patents into modern drugs with commercial potential.

The development projects include:

- a. Shenzhen Tsumura Medicine Co., Ltd for formulate standards for grading the quality of Chinese materia medica and decoction pieces in 2015
- b. Guizhou Yibai Pharmaceutical Co., Ltd for developing a paclitaxel-AS1411 conjugate to treat ovarian cancer in 2016

- c. Zhangzhou Pien Tze Huang Pharmaceutical Co., Ltd for developing a novel chalcone derivative to promote bone formation in 2017

These works represent great significance for the standardization and internationalization of Chinese medicine.

(5) Sources to corroborate the impact

- 5.1 Letter of Testimony from Robert Law, Director of the Department of Health, Hong Kong
- 5.2 Award: the ALA Presidential Citations for Innovative International Library Projects in 2012
- 5.3 Letter of Testimony from Mr. Abraham Chan, Founder, Chairman, Chief Executive Officer and Executive Director of Purapharm Corporation Limited in Hong Kong
- 5.4 Letter of Testimony from Eu Yan Sang (Hong Kong) Limited
- 5.5 Letter of Testimony from Mr. Tommy Li, Chairman of Hong Kong Chinese Medicine Industries Association
- 5.6 Award: original works prize in the Chinese book campaign “three one-hundred” in 2012 and letter of testimony from Beijing Tong Ren Tang (Hong Kong) Limited
- 5.7 Award: China’s top prize for outstanding scientific publication in 2010
- 5.8 Letter of Testimony from Mr. Vikram Channa, Vice President of Production, Discovery Networks Asia Pacific
- 5.9 The Hong Kong Baptist University Bank of China (Hong Kong) Chinese Medicines Centre website and feedback from the guest
- 5.10 Letter of appointment of Li Shizhen Museum and news about the Kam Wah Chung & Co. Museum. <http://friendsofkamwahchung.com/documents.html?fbclid=IwAR20gqZpoJwTgPWT-GGvtwCdovfblnQBkBgSjJVdhJRKWi4cjd06fvAk>,
https://www.bluemountaineagle.com/news/grant-will-help-archive-kam-wah-chung-documents/article_6bcf396c-776c-11e9-b293-675aee34e5b5.html